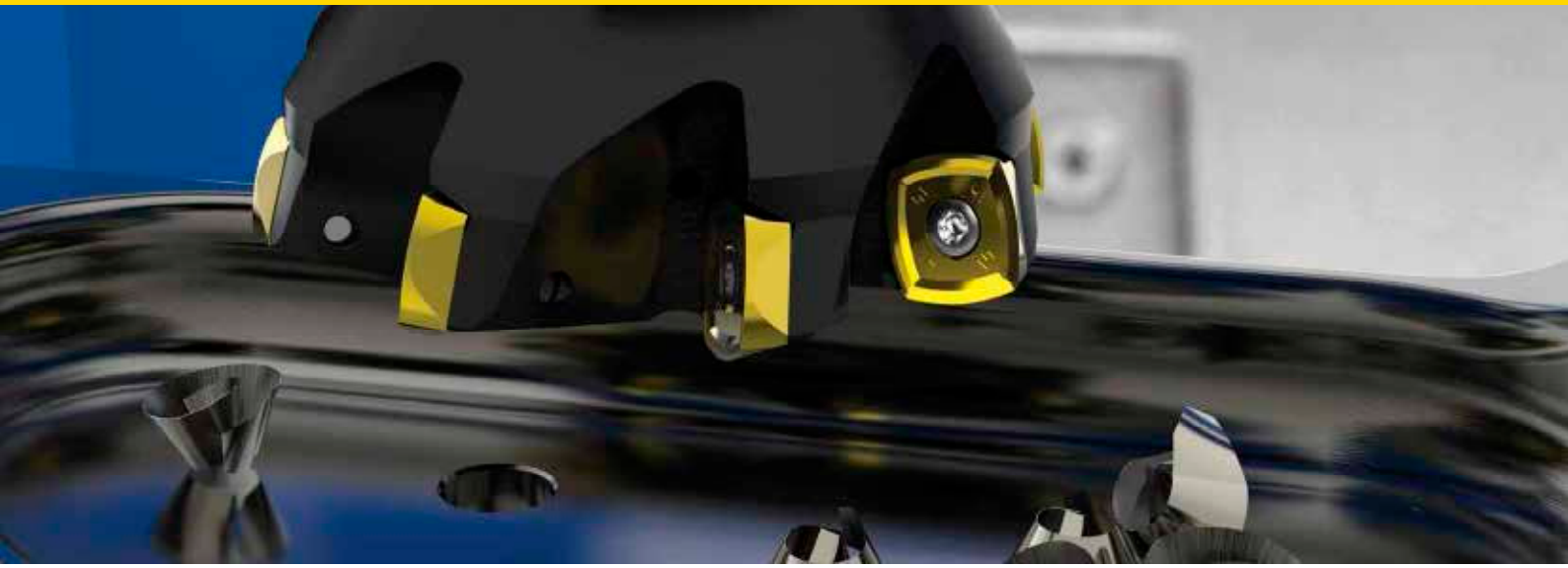
Dynamisk fræsning

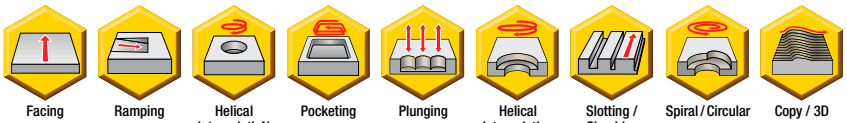
(Trochoidal Milling)

KENNAMETAL®

FORTIVA
MAKES A DIFFERENCE



STELLRAM



HIGH FEED CUTTERS

7792VX high feed milling cutters are capable of high metal removal in facing, plunging and slotting applications. The patented insert design offers better performance than round insert cutters.

The 7792VX high feed cutters are the best solution when specifically focusing on reducing cycle times or removing the maximum volume of material in the shortest time.

Our high feed cutter has the capacity to achieve 5 times higher feed rate than other existing cutters in the market. This is due to its unique design and insert positioning. 7792VX cutters also has a tremendous advantage, when used in a long (extended) toolholder. These cutters absorb vibration and greatly reduces the instability and deflection of the tool.

7792VX cutters are designed for a wide range of applications. Facing, pocketing, ramping, helical interpolation and plunging. They are capable of machining all materials such as, Steel, Stainless Steel, Cast Iron and High Temperature Alloys.

Also suitable for machining Aluminium Alloys.

7792VX

7792VXP06:
Maximum a_p = 0,90mm
Diameter Range = 16mm to 32mm

7792VXD09:
Maximum a_p = 1,50mm
Diameter Range = 25mm to 50mm

7792VXD12:
Maximum a_p = 2,50mm
Diameter Range = 32mm to 160mm

Note: Larger diameter Shell Mill Fixation cutters with interchangeable cartridges are available. Please see page A118.

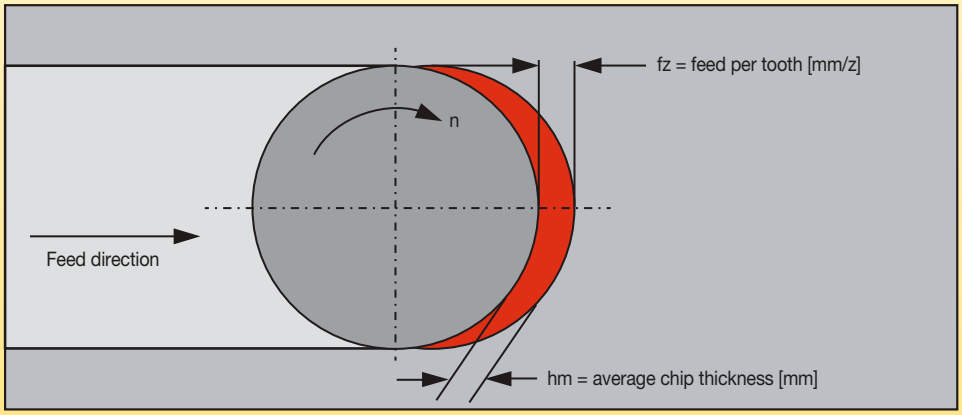
7792VXE16:
Maximum a_p = 3,50mm
Diameter Range = 63mm to 160mm

Note: Larger diameter Shell Mill Fixation cutters with interchangeable cartridges are available. Please see page A120.

Conventional Slotting

- Full slotting limitations:
  - Usually not more then ap = 1 x D.
  - Conventional and climb milling at the same time.
  - High heat development on the tool and on the workpiece.
  - Difficult chip evacuation.
  - High radial forces.

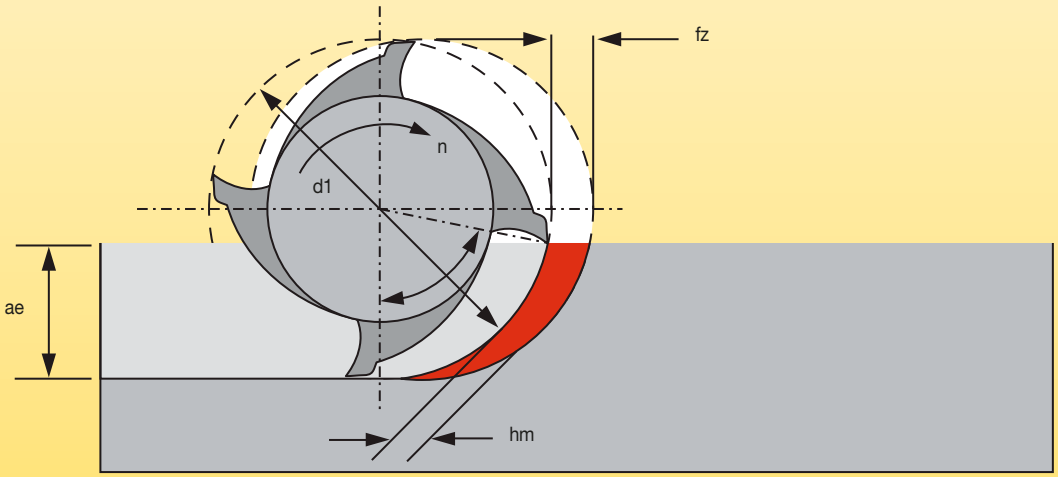
- This means:
  - No constant chip thickness.
  - Low MRR.
  - Surface quality from the left to right side are different.
  - Limited tool life.
  - High power and torque requirements for the machine.



Trochoidal Milling

- What is trochoidal milling?
  - Static trochoidal milling
  - Dynamic trochoidal milling
- What benefits do I get from trochoidal milling?
- What do I need?
- Tools for trochoidal milling
- How to

ae and Chip Thickness



To calculate average chip thickness:

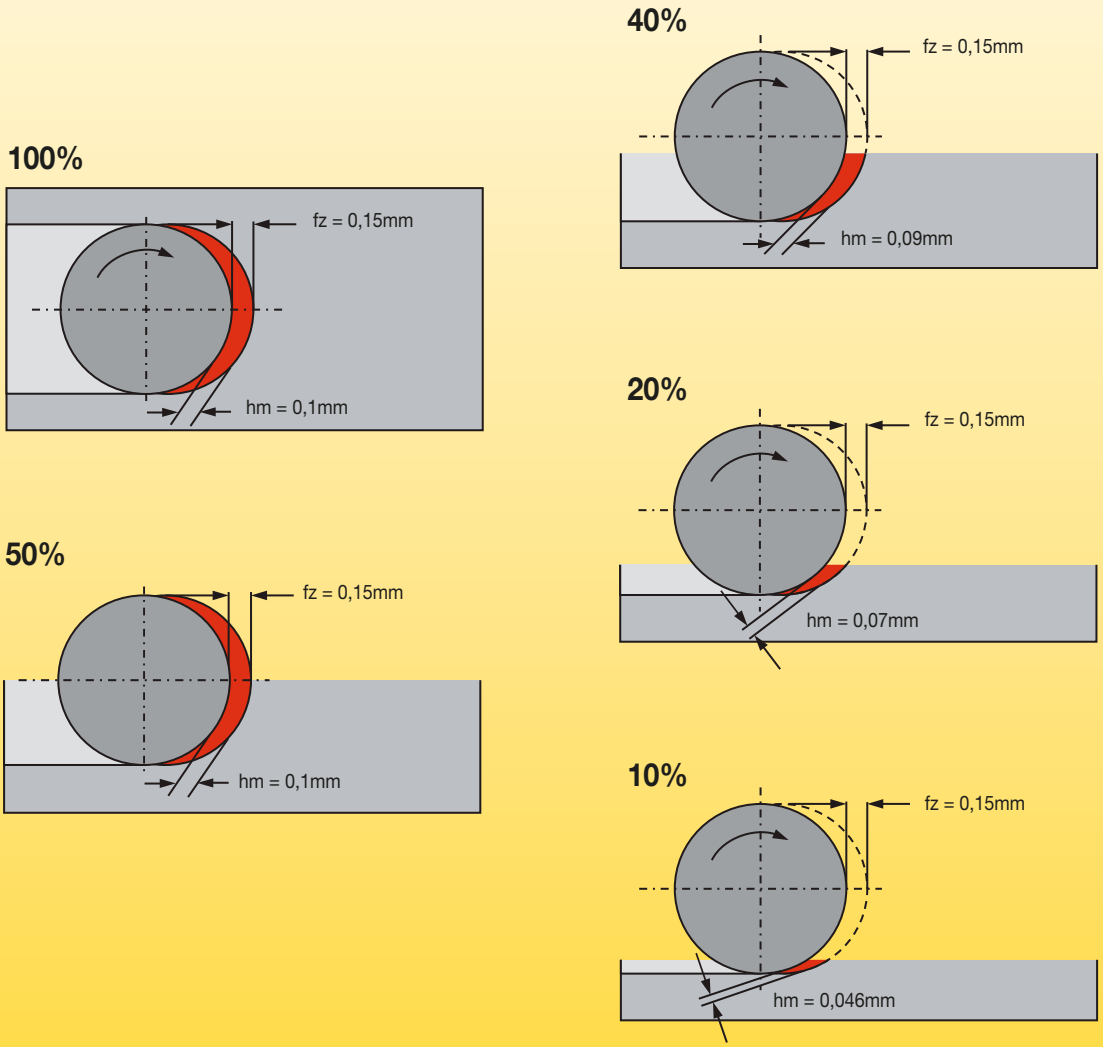
$$hm = fz \bullet \left(\sqrt{\frac{ae}{d1}}\right)$$

Simplified formula for shown application and 90° angles on the tool.
The chip thickness defines the load on the cutting edge.

ae and Chip Thickness

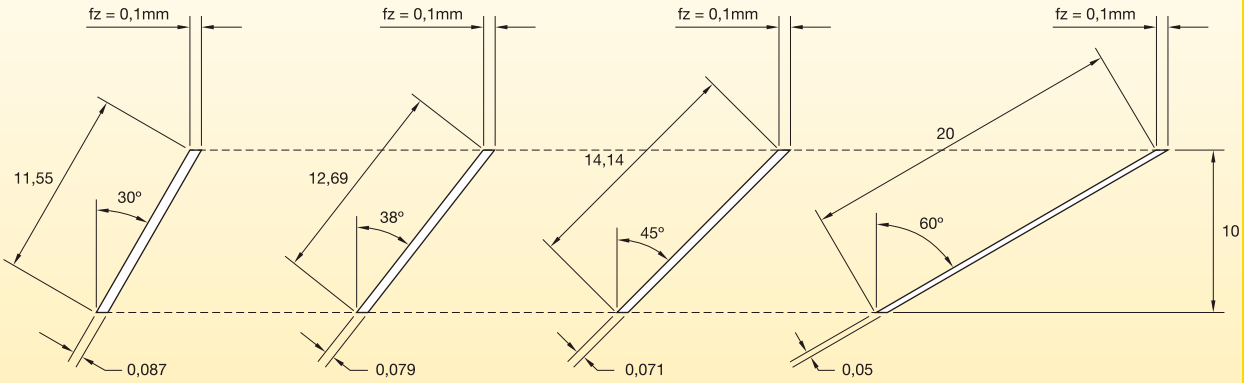
chip thinning effect		
ae	programmed feed (fz)	chip thickness (hm)
100%	0,15mm	0,1mm
50%	0,15mm	0,1mm
40%	0,15mm	0,09mm
20%	0,15mm	0,07mm
10%	0,15mm	0,046mm

The chip thickness needs to be compensated by feed.



Helix Angle and Chip Thickness

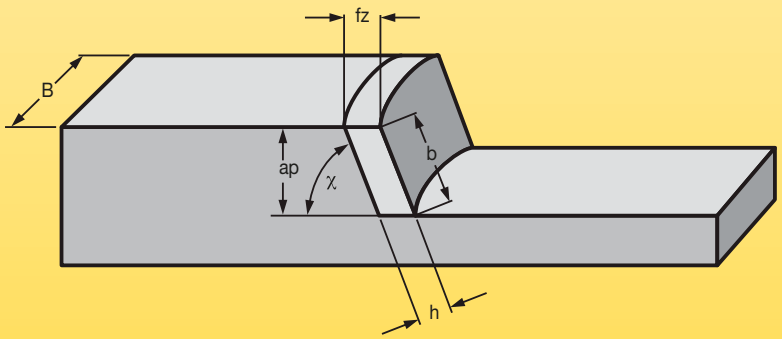
The chip thickness (h) depends on the helix angle of the cutting edge. If the feed fz is constant, the chip thickness gets thinner as helix angle rises. That means with more helix angle, the chip gets thinner — or you can rise feed rate to increase productivity and load to the cutting edge.

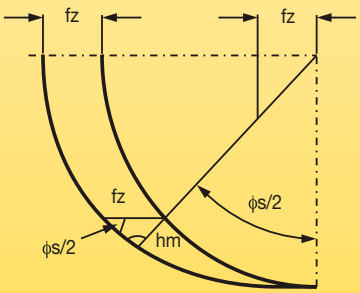


fz = 0,1mm

Calculation of Chip Thickness

The chip thickness (h) is not constant, but defines the load of the cutting edge. By reducing the load on the cutting edge, machining at higher speeds is possible through the machining parameters. For easier calculation, use an average chip thickness hm. When calculating machining data this way cutting data may be compromised because the workpiece is often a different shape.





$$hm = \frac{360°}{\pi \bullet \phi s} \bullet \frac{ae}{D} \bullet fz \bullet \sin \chi$$

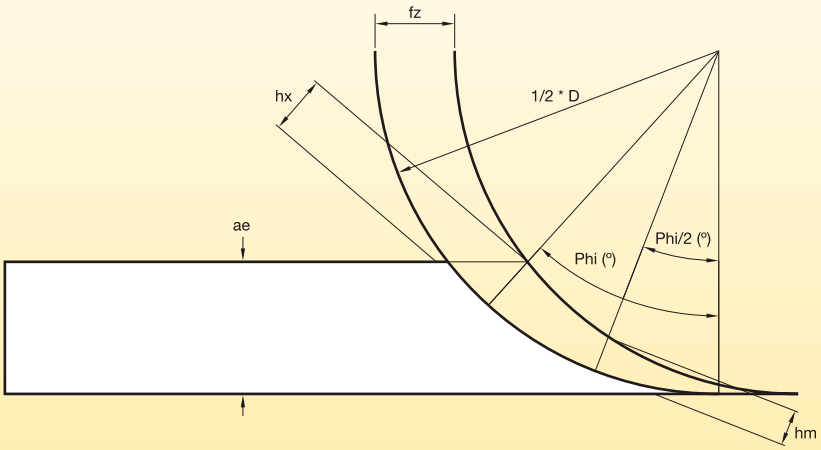
hm [mm]	=	average chip thickness
ϕs [°]	=	engagement angle
ae [mm]	=	width of engagement
D1 [mm]	=	outer diameter tool
fz [mm]	=	feed per tooth
χ [°]	=	lead angle
λ [°]	=	helix angle *

* Solid End Mills: χ = 90°-λ

Trochoidal Milling can be performed with solid or indexable milling tools.

Differences between hm and hx

In conventional milling, it makes sense to calculate the load to the cutting edge through hm. With reducing the ae to very low values, you can calculate with the maximum chip thickness hx to make sure that the feed per tooth is set up correctly.



Conventional

hm = 360°/π·φs·ae/D·fz·sin x

hm [mm]	=	average chip thickness
fs [°]	=	engagement angle
ae [mm]	=	width of engagement
D1 [mm]	=	outer diameter tool
fz [mm]	=	feed per tooth
χ [°]	=	lead angle
λ [°]	=	helix angle *

Smart Machining

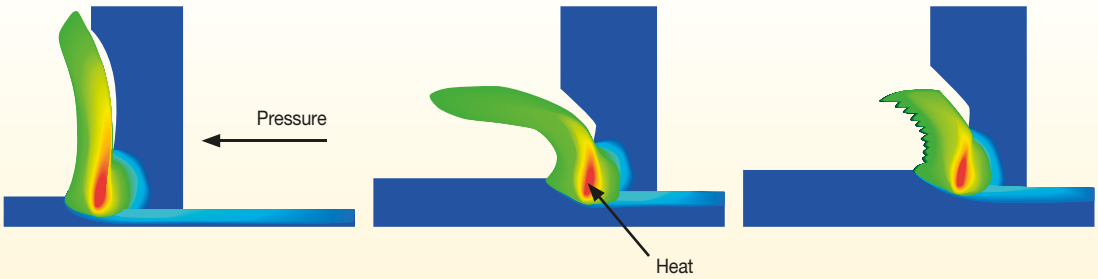
hx = 360°/π·φs·2·ae/D·fz·sin x

hx [mm]	=	maximum chip thickness
fs [°]	=	engagement angle
ae [mm]	=	width of engagement
D1 [mm]	=	outer diameter tool
fz [mm]	=	feed per tooth
χ [°]	=	lead angle
λ [°]	=	helix angle *

* Solid End Mills: χ = 90°-λ

Trochoidal Milling can be performed with solid or indexable milling tools.

Cutting Speed

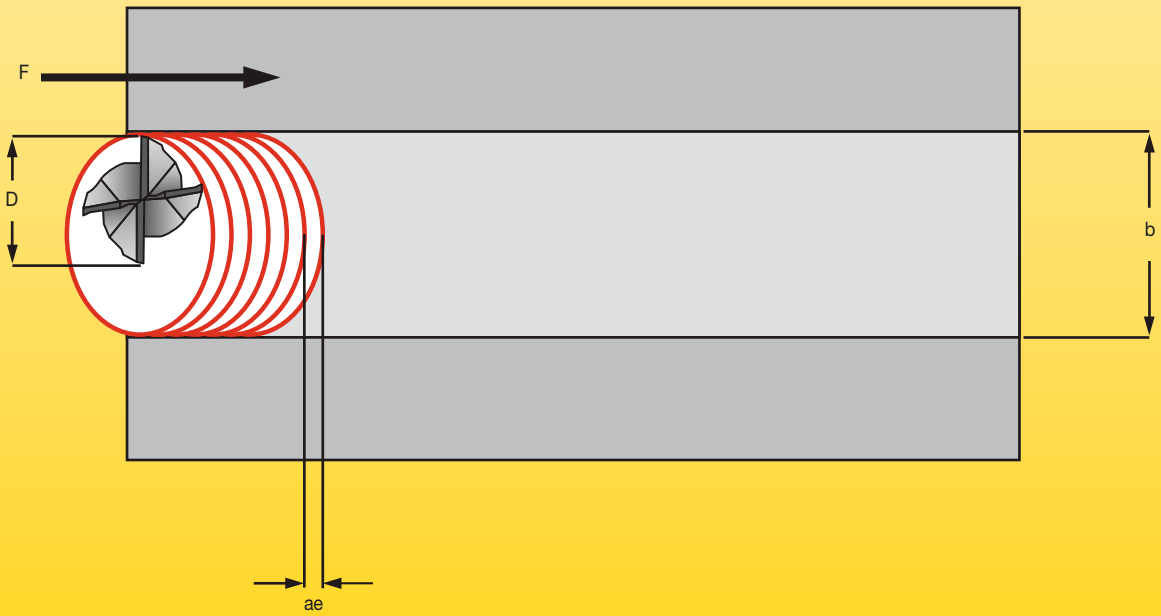


Reduced radial engagement influences the cutting speed, because the heat produced through the cutting process limits the cutting speed.

ae/D	full slot	50% ae	40% ae	30% ae	20% ae	10% ae	5% ae	4% ae
speed factors	0,9	1	1,1	1,2	1,3	1,4	2,5	3
phi [°]	180	90	78,46	66,42	53,13	36,87	25,84	23,07

Static Trochoidal Milling for a Full Slot

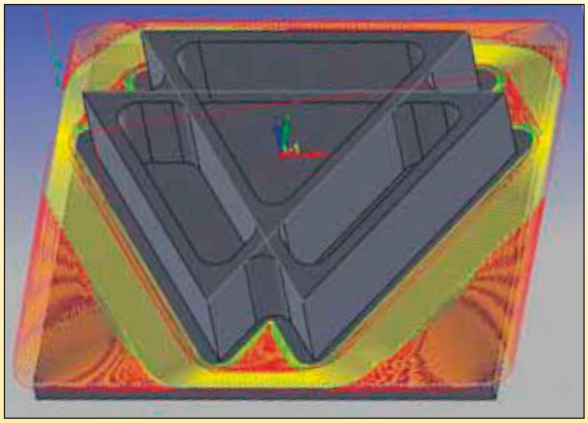
- Use a tool in which D < b.
- Program circles in the CNC program (as a cycle).
- After one circle, repeat the same with an offset.
- Optimise by shortening the lane “in the air” to a form like a “D”.

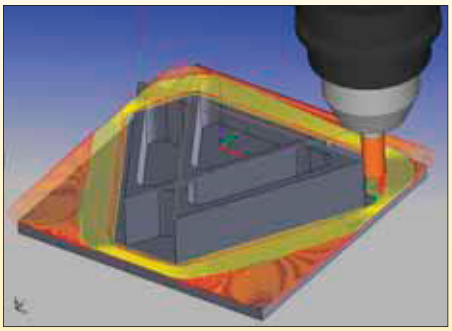


Trochoidal Milling can be performed with solid or indexable milling tools.

Dynamic Trochoidal Milling

- Transfer the basic idea control of chip thickness to dynamic processes.
- Dynamic adaption of feed in relation to ae and wrap angle through an intelligent CAM Software.
- Using helix interpolation, D-lanes, and morphing cycles.





Requirments

Static Trochoidal Milling

- Dynamic machine.
- CNC-Programming.
- Modern tool.
- Cutting data for trochoidal machining.

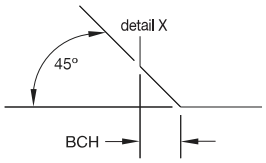
Dynamic Trochoidal Milling

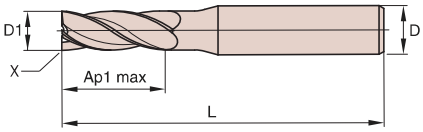
- Dynamic CNC-machine.
- CAD/CAM solutions like iMachining from SolidCAM.
- Modern tool.
- Cutting data for trochoidal machining.

Benefits

- Constant chip thickness.
- Reduced arc/angle engagement (wrap angle).
- Tremendously reduced load on the cutting edge.
- Reduced temperature during the machining process.
- Higher cutting speed and feed per tooth possible.
- Reduced cycle time and increased tool life.
- Better chip evacuation.
- Better usage of the tool length.
- Less torque and power requirements for the machine.
- Lower risk of spindle damages through torque fluctuation.
  and reduced torque peaks caused by conventional milling processes.

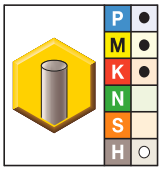
- Kennametal standard dimensions.
- Centre cutting.
- Unequal flute spacing minimises chatter for smoother machining.
- Single tool for both roughing and finishing operations requiring fewer setups.

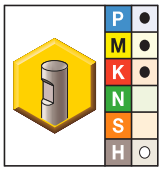




beyond

F4AS...DL • 4-Flute • Metric





● first choice
○ alternate choice

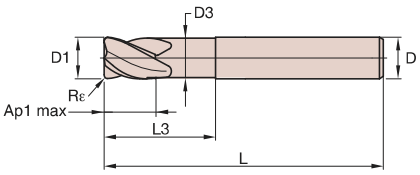
KCPM15	KCPM15	D1	D	Ap1 max	L	BCH
F4AS0400ADL38	**F4AS0400BDL38**	4,00	6,00	12,00	55,00	0,40
F4AS0500ADL38	**F4AS0500BDL38**	5,00	6,00	13,00	57,00	0,40
F4AS0600ADL38	**F4AS0600BDL38**	6,00	6,00	13,00	57,00	0,40
F4AS0800ADL38	**F4AS0800BDL38**	8,00	8,00	16,00	63,00	0,40
F4AS1000ADL38	**F4AS1000BDL38**	10,00	10,00	22,00	72,00	0,50
F4AS1200ADL38	**F4AS1200BDL38**	12,00	12,00	26,00	83,00	0,50
F4AS1400ADL38	**F4AS1400BDL38**	14,00	14,00	26,00	83,00	0,50
F4AS1600ADL38	**F4AS1600BDL38**	16,00	16,00	32,00	92,00	0,50
F4AS1800ADL38	**F4AS1800BDL38**	18,00	18,00	32,00	92,00	0,50
F4AS2000ADL38	**F4AS2000BDL38**	20,00	20,00	38,00	104,00	0,50
F4AS2500ADL38	**F4AS2500BDL38**	25,00	25,00	45,00	121,00	0,50

NOTE: For application data, see page C20.

End Mill Tolerances

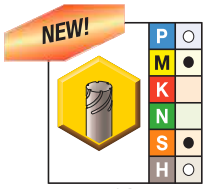
D1	tolerance e8	D	tolerance h6
≤3	-0,014/-0,028	≤3	+0/-0,006
>3–6	-0,020/-0,038	>3–6	+0/-0,008
>6–10	-0,025/-0,047	>6–10	+0/-0,009
>10–18	-0,032/-0,059	>10–18	+0/-0,011
>18–30	-0,040/-0,073	>18–30	+0/-0,013

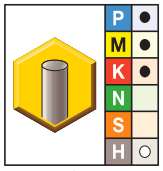
- Kennametal standard dimensions.
- Centre cutting.
- Unequal flute spacing minimises chatter for smoother machining.
- Single tool for both roughing and finishing operations requiring fewer setups.

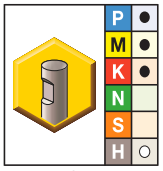


beyond

UBDE • F4AS.. • 4-Flute with Neck • Metric





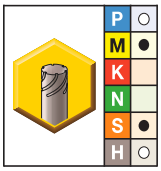


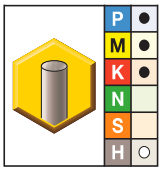
● first choice
○ alternate choice

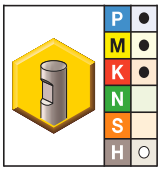
KCSM15	KCPM15	KCPM15	D1	D	D3	Ap1 max	L3	L	Rε
–	F4AS0600AWM38R050	F4AS0600BWM38R050	6,00	6,00	5,64	9,00	18,00	63,00	0,50
–	F4AS0600AWM38R100	F4AS0600BWM38R100	6,00	6,00	5,64	9,00	18,00	63,00	1,00
–	F4AS0800AWM38R050	F4AS0800BWM38R050	8,00	8,00	7,52	12,00	24,00	68,00	0,50
–	F4AS0800AWM38R100	F4AS0800BWM38R100	8,00	8,00	7,52	12,00	24,00	68,00	1,00
–	F4AS1000AWL38R050	F4AS1000BWL38R050	10,00	10,00	9,40	15,00	30,00	76,00	0,50
–	F4AS1000AWL38R100	F4AS1000BWL38R100	10,00	10,00	9,40	15,00	30,00	76,00	1,00
–	F4AS1000AWL38R200	F4AS1000BWL38R200	10,00	10,00	9,40	15,00	30,00	76,00	2,00
–	F4AS1000AWL38R300	F4AS1000BWL38R300	10,00	10,00	9,40	15,00	30,00	76,00	3,00
–	F4AS1000AWL38R400	F4AS1000BWL38R400	10,00	10,00	9,40	15,00	30,00	76,00	4,00
UBDE1200E4AQE	F4AS1200AWL38R050	F4AS1200BWL38R050	12,00	12,00	11,28	18,00	36,00	83,00	0,50
UBDE1200E4AQG	F4AS1200AWL38R100	F4AS1200BWL38R100	12,00	12,00	11,28	18,00	36,00	83,00	1,00
UBDE1200E4AQK	F4AS1200AWL38R200	F4AS1200BWL38R200	12,00	12,00	11,28	18,00	36,00	83,00	2,00
UBDE1200E4AQM	F4AS1200AWL38R300	F4AS1200BWL38R300	12,00	12,00	11,28	18,00	36,00	83,00	3,00
UBDE1200E4AQN	F4AS1200AWL38R400	F4AS1200BWL38R400	12,00	12,00	11,28	18,00	36,00	83,00	4,00
UBDE1600E4AQE	F4AS1600AWX38R050	F4AS1600BWX38R050	16,00	16,00	15,04	24,00	48,00	100,00	0,50
UBDE1600E4AQG	F4AS1600AWX38R100	F4AS1600BWX38R100	16,00	16,00	15,04	24,00	48,00	100,00	1,00
UBDE1600E4AQK	F4AS1600AWX38R200	F4AS1600BWX38R200	16,00	16,00	15,04	24,00	48,00	100,00	2,00
UBDE1600E4AQM	F4AS1600AWX38R300	F4AS1600BWX38R300	16,00	16,00	15,04	24,00	48,00	100,00	3,00
UBDE1600E4AQN	F4AS1600AWX38R400	F4AS1600BWX38R400	16,00	16,00	15,04	24,00	48,00	100,00	4,00
UBDE2000E4AQE	F4AS2000AWX38R050	F4AS2000BWX38R050	20,00	20,00	18,80	30,00	60,00	115,00	0,50

(continued)

(UBDE • F4AS.. • 4-Flute with Neck • Metric continued)







KCSM15	KCPM15	KCPM15	D1	D	D3	Ap1 max	L3	L	Rε
UBDE2000E4AQG	**F4AS2000AWX38R100**	**F4AS2000BWX38R100**	20,00	20,00	18,80	30,00	60,00	115,00	1,00
UBDE2000E4AQK	**F4AS2000AWX38R200**	**F4AS2000BWX38R200**	20,00	20,00	18,80	30,00	60,00	115,00	2,00
UBDE2000E4AQM	**F4AS2000AWX38R300**	**F4AS2000BWX38R300**	20,00	20,00	18,80	30,00	60,00	115,00	3,00
UBDE2000E4AQN	**F4AS2000AWX38R400**	**F4AS2000BWX38R400**	20,00	20,00	18,80	30,00	60,00	115,00	4,00
UBDE2500E4AQE	**F4AS2500AWX38R050**	**F4AS2500BWX38R050**	25,00	25,00	23,50	37,50	75,00	135,00	0,50
UBDE2500E4AQG	**F4AS2500AWX38R100**	**F4AS2500BWX38R100**	25,00	25,00	23,50	37,50	75,00	135,00	1,00
UBDE2500E4AQK	**F4AS2500AWX38R200**	**F4AS2500BWX38R200**	25,00	25,00	23,50	37,50	75,00	135,00	2,00
UBDE2500E4AQM	**F4AS2500AWX38R300**	**F4AS2500BWX38R300**	25,00	25,00	23,50	37,50	75,00	135,00	3,00
UBDE2500E4AQN	**F4AS2500AWX38R400**	**F4AS2500BWX38R400**	25,00	25,00	23,50	37,50	75,00	135,00	4,00

NOTE: For application data, see page C21.

End Mill Tolerances

D1	tolerance e8	D	tolerance h6
≤3	-0,014/-0,028	≤3	+0/-0,006
>3–6	-0,020/-0,038	>3–6	+0/-0,008
>6–10	-0,025/-0,047	>6–10	+0/-0,009
>10–18	-0,032/-0,059	>10–18	+0/-0,011
>18–30	-0,040/-0,073	>18–30	+0/-0,013

ae/D	50% ae	40% ae	30% ae	20% ae	10% ae	5% ae	4% ae	2% ae
Speed factors vc	1	1.1	1.2	1.3	1.4	2.5	3	4
Feed factors fz	1	1	1.1	1.4	2	2.5	3	4.4
phi [°]	90	78.46	66.42	53.13	36.87	25.84	23.07	16.26

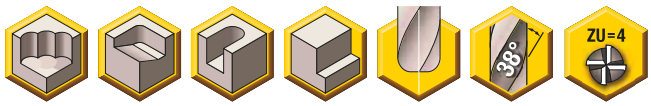
Material Group		Cutting Speed – vc m/min	D	4	6	8	10	12	16	20	25	
P	1	vc max [m/min]	vf	16488	17273	17666	16959	16292	14869	13426	11683	mm/min
		600	n	47746	31831	23873	19099	15915	11937	9549	7639	min^{-1}
	2	vc max [m/min]	vf	15663	16409	16782	16111	15477	14125	12755	11099	mm/min
		570	n	45359	30239	22680	18144	15120	11340	9072	7257	min^{-1}
	3	vc max [m/min]	vf	11668	12224	12502	12002	11529	10522	9501	8268	mm/min
		480	n	38197	25465	19099	15279	12732	9549	7639	6112	min^{-1}
	4	vc max [m/min]	vf	9512	9965	10192	9784	9399	8578	7746	6740	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	5	vc max [m/min]	vf	5707	5979	6115	5870	5639	5147	4647	4044	mm/min
		300	n	23873	15915	11937	9549	7958	5968	4775	3820	min^{-1}
	6	vc max [m/min]	vf	3567	3737	3822	3669	3525	3217	2905	2528	mm/min
		225	n	17905	11937	8952	7162	5968	4476	3581	2865	min^{-1}
M	1	vc max [m/min]	vf	8387	8786	8986	8626	8287	7563	6829	5943	mm/min
		345	n	27454	18303	13727	10982	9151	6864	5491	4393	min^{-1}
	2	vc max [m/min]	vf	4566	4783	4892	4696	4512	4117	3718	3235	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	3	vc max [m/min]	vf	3329	3488	3567	3424	3290	3002	2711	2359	mm/min
		210	n	16711	11141	8356	6685	5570	4178	3342	2674	min^{-1}
K	1	vc max [m/min]	vf	12366	12955	13249	12719	12219	11151	10069	8762	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	2	vc max [m/min]	vf	9481	9932	10158	9751	9368	8549	7720	6718	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
	3	vc max [m/min]	vf	7420	7773	7949	7632	7331	6691	6042	5257	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
S	1	vc max [m/min]	vf	6563	6876	7032	6751	6485	5919	5345	4651	mm/min
		270	n	21486	14324	10743	8594	7162	5371	4297	3438	min^{-1}
	2	vc max [m/min]	vf	1522	1594	1631	1565	1504	1372	1239	1078	mm/min
		120	n	9549	6366	4775	3820	3183	2387	1910	1528	min^{-1}
	3	vc max [m/min]	vf	4566	4783	4892	4696	4512	4117	3718	3235	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	4	vc max [m/min]	vf	3044	3189	3261	3131	3008	2745	2479	2157	mm/min
		180	n	14324	9549	7162	5730	4775	3581	2865	2292	min^{-1}
H	1	vc max [m/min]	vf	8878	9301	9512	9132	8772	8006	7229	6291	mm/min
		420	n	33423	22282	16711	13369	11141	8356	6685	5348	min^{-1}

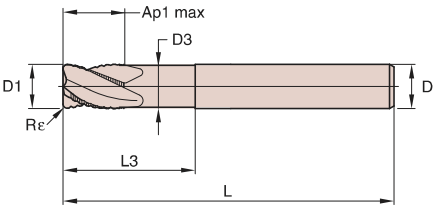
NOTE: For all other combinations of width and depth of cut, feed and speed must be adapted.
Cutting data, which are shown in this catalogue, are applicable under optimum conditions and chip evacuation.

Recommended ae: 0,04 x D, phi~23°, ap = ap max

Speed and feed: 4% ae

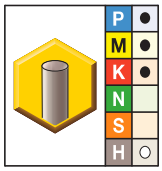
- Kennametal standard dimensions.
- Centre cutting.
- Unequal flute spacing minimises chatter for smoother machining.
- Chipbreaker profile.

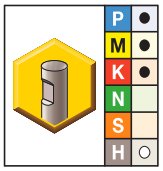




beyond

F4BS.. • 4-Flute with Neck and Chipbreaker • Metric





● first choice
○ alternate choice

KCPM15	KCPM15	D1	D	D3	Ap1 max	L3	L	Rε
F4BS0600AWM38R050	F4BS0600BWM38R050	6,00	6,00	5,80	9,00	18,00	63,00	0,50
F4BS0600AWM38R100	F4BS0600BWM38R100	6,00	6,00	5,80	9,00	18,00	63,00	1,00
F4BS0800AWM38R050	F4BS0800BWM38R050	8,00	8,00	7,80	12,00	24,00	68,00	0,50
F4BS0800AWM38R100	F4BS0800BWM38R100	8,00	8,00	7,80	12,00	24,00	68,00	1,00
F4BS1000AWL38R050	F4BS1000BWL38R050	10,00	10,00	9,50	15,00	30,00	76,00	0,50
F4BS1000AWL38R100	F4BS1000BWL38R100	10,00	10,00	9,50	15,00	30,00	76,00	1,00
F4BS1000AWL38R200	F4BS1000BWL38R200	10,00	10,00	9,50	15,00	30,00	76,00	2,00
F4BS1000AWL38R300	F4BS1000BWL38R300	10,00	10,00	9,50	15,00	30,00	76,00	3,00
F4BS1000AWL38R400	F4BS1000BWL38R400	10,00	10,00	9,50	15,00	30,00	76,00	4,00
F4BS1200AWL38R050	F4BS1200BWL38R050	12,00	12,00	11,50	18,00	36,00	84,00	0,50
F4BS1200AWL38R100	F4BS1200BWL38R100	12,00	12,00	11,50	18,00	36,00	84,00	1,00
F4BS1200AWL38R200	F4BS1200BWL38R200	12,00	12,00	11,50	18,00	36,00	84,00	2,00
F4BS1200AWL38R300	F4BS1200BWL38R300	12,00	12,00	11,50	18,00	36,00	84,00	3,00
F4BS1200AWL38R400	F4BS1200BWL38R400	12,00	12,00	11,50	18,00	36,00	84,00	4,00
F4BS1600AWX38R050	F4BS1600BWX38R050	16,00	16,00	15,00	24,00	48,00	100,00	0,50
F4BS1600AWX38R100	F4BS1600BWX38R100	16,00	16,00	15,00	24,00	48,00	100,00	1,00
F4BS1600AWX38R200	F4BS1600BWX38R200	16,00	16,00	15,00	24,00	48,00	100,00	2,00
F4BS1600AWX38R300	F4BS1600BWX38R300	16,00	16,00	15,00	24,00	48,00	100,00	3,00
F4BS1600AWX38R400	F4BS1600BWX38R400	16,00	16,00	15,00	24,00	48,00	100,00	4,00
F4BS2000AWX38R050	F4BS2000BWX38R050	20,00	20,00	19,00	30,00	60,00	115,00	0,50
F4BS2000AWX38R100	F4BS2000BWX38R100	20,00	20,00	19,00	30,00	60,00	115,00	1,00
F4BS2000AWX38R200	F4BS2000BWX38R200	20,00	20,00	19,00	30,00	60,00	115,00	2,00
F4BS2000AWX38R300	F4BS2000BWX38R300	20,00	20,00	19,00	30,00	60,00	115,00	3,00
F4BS2000AWX38R400	F4BS2000BWX38R400	20,00	20,00	19,00	30,00	60,00	115,00	4,00
F4BS2500AWX38R050	F4BS2500BWX38R050	25,00	25,00	24,00	37,50	75,00	135,00	0,50
F4BS2500AWX38R100	F4BS2500BWX38R100	25,00	25,00	24,00	37,50	75,00	135,00	1,00
F4BS2500AWX38R200	F4BS2500BWX38R200	25,00	25,00	24,00	37,50	75,00	135,00	2,00
F4BS2500AWX38R300	F4BS2500BWX38R300	25,00	25,00	24,00	37,50	75,00	135,00	3,00
F4BS2500AWX38R400	F4BS2500BWX38R400	25,00	25,00	24,00	37,50	75,00	135,00	4,00

NOTE: For application data, see page C21.

End Mill Tolerances

D1	tolerance e8	D	tolerance h6
≤3	-0,014/-0,028	≤3	+0/-0,006
>3–6	-0,020/-0,038	>3–6	+0/-0,008
>6–10	-0,025/-0,047	>6–10	+0/-0,009
>10–18	-0,032/-0,059	>10–18	+0/-0,011
>18–30	-0,040/-0,073	>18–30	+0/-0,013

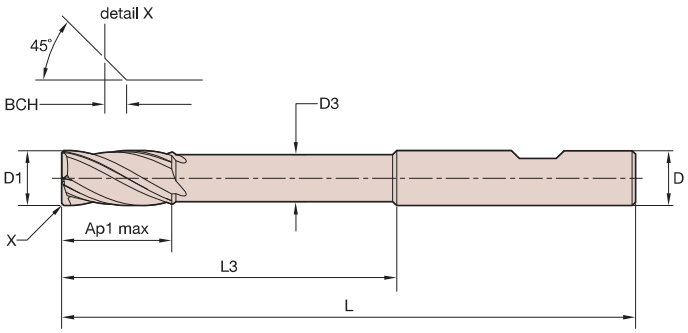
ae/D	50% ae	40% ae	30% ae	20% ae	10% ae	5% ae	4% ae	2% ae
Speed factors vc	1	1.1	1.2	1.3	1.4	2.5	3	4
Feed factors fz	1	1	1.1	1.4	2	2.5	3	4.4
phi [°]	90	78.46	66.42	53.13	36.87	25.84	23.07	16.26

Material Group		Cutting Speed – vc m/min	D	4	6	8	10	12	16	20	25	
P	1	vc max [m/min]	vf	16488	17273	17666	16959	16292	14869	13426	11683	mm/min
		600	n	47746	31831	23873	19099	15915	11937	9549	7639	min^{-1}
	2	vc max [m/min]	vf	15663	16409	16782	16111	15477	14125	12755	11099	mm/min
		570	n	45359	30239	22680	18144	15120	11340	9072	7257	min^{-1}
	3	vc max [m/min]	vf	11668	12224	12502	12002	11529	10522	9501	8268	mm/min
		480	n	38197	25465	19099	15279	12732	9549	7639	6112	min^{-1}
	4	vc max [m/min]	vf	9512	9965	10192	9784	9399	8578	7746	6740	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	5	vc max [m/min]	vf	5707	5979	6115	5870	5639	5147	4647	4044	mm/min
		300	n	23873	15915	11937	9549	7958	5968	4775	3820	min^{-1}
	6	vc max [m/min]	vf	3567	3737	3822	3669	3525	3217	2905	2528	mm/min
		225	n	17905	11937	8952	7162	5968	4476	3581	2865	min^{-1}
M	1	vc max [m/min]	vf	8387	8786	8986	8626	8287	7563	6829	5943	mm/min
		345	n	27454	18303	13727	10982	9151	6864	5491	4393	min^{-1}
	2	vc max [m/min]	vf	4566	4783	4892	4696	4512	4117	3718	3235	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	3	vc max [m/min]	vf	3329	3488	3567	3424	3290	3002	2711	2359	mm/min
		210	n	16711	11141	8356	6685	5570	4178	3342	2674	min^{-1}
K	1	vc max [m/min]	vf	12366	12955	13249	12719	12219	11151	10069	8762	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	2	vc max [m/min]	vf	9481	9932	10158	9751	9368	8549	7720	6718	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
	3	vc max [m/min]	vf	7420	7773	7949	7632	7331	6691	6042	5257	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
S	1	vc max [m/min]	vf	6563	6876	7032	6751	6485	5919	5345	4651	mm/min
		270	n	21486	14324	10743	8594	7162	5371	4297	3438	min^{-1}
	2	vc max [m/min]	vf	1522	1594	1631	1565	1504	1372	1239	1078	mm/min
		120	n	9549	6366	4775	3820	3183	2387	1910	1528	min^{-1}
	3	vc max [m/min]	vf	4566	4783	4892	4696	4512	4117	3718	3235	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	4	vc max [m/min]	vf	3044	3189	3261	3131	3008	2745	2479	2157	mm/min
		180	n	14324	9549	7162	5730	4775	3581	2865	2292	min^{-1}
H	1	vc max [m/min]	vf	8878	9301	9512	9132	8772	8006	7229	6291	mm/min
		420	n	33423	22282	16711	13369	11141	8356	6685	5348	min^{-1}

NOTE: For all other combinations of width and depth of cut, feed and speed must be adapted.
Cutting data, which are shown in this catalogue, are applicable under optimum conditions and chip evacuation.

Recommended ae: 0,04 x D, phi~23°, ap = ap max
Speed and feed: 4% ae

- Kennametal standard dimensions.
- Centre cutting.
- Unequal flute spacing minimises chatter for smoother machining.
- Single tool for both roughing and finishing operations requiring fewer setups.



beyond

UADE • 4-Flute Extended Reach • Metric

● first choice
○ alternate choice

KCPM15	KCPM15	D1	D	D3	Ap1 max	L3	L	BCH
UADE0600A4AL	UADE0600B4AL	6,0	6	5,50	12,00	42,00	100	0,40
UADE0800A4AL	UADE0800B4AL	8,0	8	7,30	16,00	62,00	100	0,40
UADE1000A4AL	UADE1000B4AL	10,0	10	9,10	20,00	60,00	100	0,50
UADE1200A4AL	UADE1200B4AL	12,0	12	11,00	24,00	73,00	125	0,50
UADE1600A4AL	UADE1600B4AL	16,0	16	15,00	32,00	100,00	150	0,50
UADE2000A4AL	UADE2000B4AL	20,0	20	19,00	40,00	98,00	175	0,50

NOTE: For application data, see page C22.

End Mill Tolerances

D1	tolerance e8	D	tolerance h6 + / -
≤ 3	-0,014/-0,028	≤ 3	0/0,006
> 3-6	-0,020/-0,038	> 3–6	0/0,008
> 6–10	-0,025/-0,047	> 6–10	0/0,009
> 10–18	-0,032/-0,059	> 10–18	0/0,011
> 18–30	-0,040/-0,073	> 18–30	0/0,013

ae/D	5% ae	4% ae	2% ae
Speed factors vc	2.5	3	4
Feed factors fz	2.5	3	4.4
phi [°]	25.84	23.07	16.26

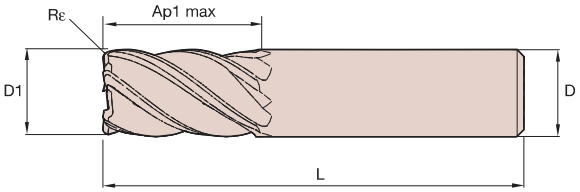
Material Group		Cutting Speed – vc m/min	D	4	6	8	10	12	16	20	25	
P	1	vc max [m/min]	vf	14747	15449	15801	15169	14572	13299	12008	10449	mm/min
		600	n	47746	31831	23873	19099	15915	11937	9549	7639	min^{-1}
	2	vc max [m/min]	vf	14010	14677	15011	14410	13843	12634	11408	9927	mm/min
		570	n	45359	30239	22680	18144	15120	11340	9072	7257	min^{-1}
	3	vc max [m/min]	vf	10436	10933	11182	10735	10312	9411	8498	7395	mm/min
		480	n	38197	25465	19099	15279	12732	9549	7639	6112	min^{-1}
	4	vc max [m/min]	vf	8508	8913	9116	8751	8407	7672	6928	6029	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	5	vc max [m/min]	vf	5105	5348	5469	5251	5044	4603	4157	3617	mm/min
		300	n	23873	15915	11937	9549	7958	5968	4775	3820	min^{-1}
	6	vc max [m/min]	vf	3190	3342	3418	3282	3153	2877	2598	2261	mm/min
		225	n	17905	11937	8952	7162	5968	4476	3581	2865	min^{-1}
M	1	vc max [m/min]	vf	7501	7858	8037	7716	7412	6764	6108	5315	mm/min
		345	n	27454	18303	13727	10982	9151	6864	5491	4393	min^{-1}
	2	vc max [m/min]	vf	4084	4278	4376	4201	4035	3683	3325	2894	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	3	vc max [m/min]	vf	2978	3120	3190	3063	2942	2685	2425	2110	mm/min
		210	n	16711	11141	8356	6685	5570	4178	3342	2674	min^{-1}
K	1	vc max [m/min]	vf	11060	11587	11850	11376	10929	9974	9006	7837	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	2	vc max [m/min]	vf	8480	8883	9085	8722	8379	7647	6905	6008	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
	3	vc max [m/min]	vf	6636	6952	7110	6826	6557	5984	5404	4702	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
S	1	vc max [m/min]	vf	5871	6150	6290	6038	5801	5294	4780	4160	mm/min
		270	n	21486	14324	10743	8594	7162	5371	4297	3438	min^{-1}
	2	vc max [m/min]	vf	1361	1426	1459	1400	1345	1228	1108	965	mm/min
		120	n	9549	6366	4775	3820	3183	2387	1910	1528	min^{-1}
	3	vc max [m/min]	vf	4084	4278	4376	4201	4035	3683	3325	2894	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	4	vc max [m/min]	vf	2723	2852	2917	2800	2690	2455	2217	1929	mm/min
		180	n	14324	9549	7162	5730	4775	3581	2865	2292	min^{-1}
H	1	vc max [m/min]	vf	7941	8319	8508	8168	7846	7161	6466	5627	mm/min
		420	n	33423	22282	16711	13369	11141	8356	6685	5348	min^{-1}

NOTE: For all other combinations of width and depth of cut, feed and speed must be adapted.
Cutting data, which are shown in this catalogue, are applicable under optimum conditions and chip evacuation.

Recommended ae: 0,05 x D, phi~28,8°, ap = ap max

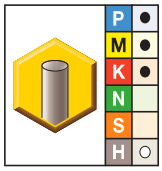
Speed and feed: 5% ae

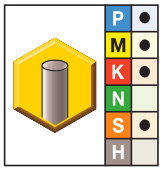
- Kennametal standard dimensions.
- Non-centre cutting.
- Ramping up to 3°.
- Unequal flute spacing minimises chatter for smoother machining.
- Single tool for both roughing and finishing operations requiring fewer setups.
- Five-flute geometry enables slotting up to 1 x D.

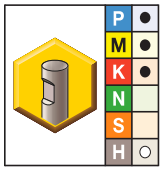


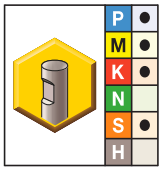
beyond

UCDE • 5-Flute • Metric









● first choice
○ alternate choice

KCPM15	KC643M	KCPM15	KC643M	D1	D	Ap1 max	L	Rε
UCDE0400A5ARA	UCDE0400A5ARA	UCDE0400B5ARA	UCDE0400B5ARA	4,00	6,00	11,00	55,00	0,25
UCDE0400A5ASA	UCDE0400A5ASA	–	–	4,00	6,00	11,00	55,00	–
UCDE0500A5ARA	UCDE0500A5ARA	UCDE0500B5ARA	UCDE0500B5ARA	5,00	6,00	13,00	57,00	0,25
UCDE0500A5ASA	UCDE0500A5ASA	–	–	5,00	6,00	13,00	57,00	–
UCDE0600A5ARA	UCDE0600A5ARA	UCDE0600B5ARA	UCDE0600B5ARA	6,00	6,00	13,00	57,00	0,40
UCDE0600A5ASA	UCDE0600A5ASA	–	–	6,00	6,00	13,00	57,00	–
UCDE0700A5ARA	UCDE0700A5ARA	UCDE0700B5ARA	UCDE0700B5ARA	7,00	8,00	16,00	63,00	0,40
UCDE0700A5ASA	UCDE0700A5ASA	–	–	7,00	8,00	16,00	63,00	–
UCDE0800A5ARA	UCDE0800A5ARA	UCDE0800B5ARA	UCDE0800B5ARA	8,00	8,00	19,00	63,00	0,50
UCDE0800A5ASA	UCDE0800A5ASA	–	–	8,00	8,00	19,00	63,00	–
UCDE0900A5ARA	UCDE0900A5ARA	UCDE0900B5ARA	UCDE0900B5ARA	9,00	10,00	19,00	72,00	0,50
UCDE0900A5ASA	UCDE0900A5ASA	–	–	9,00	10,00	19,00	72,00	–
UCDE1000A5ARA	UCDE1000A5ARA	UCDE1000B5ARA	UCDE1000B5ARA	10,00	10,00	22,00	72,00	0,50
UCDE1000A5ASA	UCDE1000A5ASA	–	–	10,00	10,00	22,00	72,00	–
UCDE1200A5ARA	UCDE1200A5ARA	UCDE1200B5ARA	UCDE1200B5ARA	12,00	12,00	26,00	83,00	0,75
UCDE1200A5ASA	UCDE1200A5ASA	–	–	12,00	12,00	26,00	83,00	–
UCDE1400A5ARA	UCDE1400A5ARA	UCDE1400B5ARA	UCDE1400B5ARA	14,00	14,00	26,00	83,00	0,75
UCDE1400A5ASA	UCDE1400A5ASA	–	–	14,00	14,00	26,00	83,00	–
UCDE1600A5ARA	UCDE1600A5ARA	UCDE1600B5ARA	UCDE1600B5ARA	16,00	16,00	32,00	92,00	0,75
UCDE1600A5ASA	UCDE1600A5ASA	–	–	16,00	16,00	32,00	92,00	–
UCDE1800A5ARA	UCDE1800A5ARA	UCDE1800B5ARA	UCDE1800B5ARA	18,00	18,00	32,00	92,00	0,75
UCDE1800A5ASA	UCDE1800A5ASA	–	–	18,00	18,00	32,00	92,00	–
UCDE2000A5ARA	UCDE2000A5ARA	UCDE2000B5ARA	UCDE2000B5ARA	20,00	20,00	38,00	104,00	0,75
UCDE2000A5ASA	UCDE2000A5ASA	–	–	20,00	20,00	38,00	104,00	–
UCDE2500A5ARA	UCDE2500A5ARA	UCDE2500B5ARA	UCDE2500B5ARA	25,00	25,00	45,00	121,00	0,75
UCDE2500A5ASA	UCDE2500A5ASA	–	–	25,00	25,00	45,00	121,00	–

NOTE: For application data, see page C29.

End Mill Tolerances

D1	tolerance e8	D	tolerance h6
≤3	-0,014/-0,028	≤3	+0/-0,006
>3–6	-0,020/-0,038	>3–6	+0/-0,008
>6–10	-0,025/-0,047	>6–10	+0/-0,009
>10–18	-0,032/-0,059	>10–18	+0/-0,011
>18–30	-0,040/-0,073	>18–30	+0/-0,013

ae/D	Full Slot	50% ae	40% ae	30% ae	20% ae	10% ae	5% ae	4% ae	2% ae
Speed factors vc	0.9	1	1.1	1.2	1.3	1.4	2.5	3	4
Feed factors fz	0.8	1	1	1.1	1.4	2	2.5	3	4.4
phi [°]	180	90	78.46	66.42	53.13	36.87	25.84	23.07	16.26

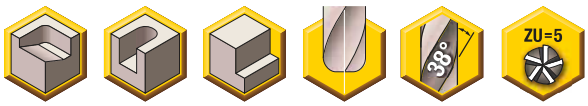
Material Group		Cutting Speed – vc m/min	D	4	6	8	10	12	16	20	25	
P	1	vc max [m/min]	vf	20610	21591	22082	21199	20364	18586	16782	14604	mm/min
		600	n	47746	31831	23873	19099	15915	11937	9549	7639	min^{-1}
	2	vc max [m/min]	vf	19579	20512	20978	20139	19346	17656	15943	13873	mm/min
		570	n	45359	30239	22680	18144	15120	11340	9072	7257	min^{-1}
	3	vc max [m/min]	vf	14585	15280	15627	15002	14412	13153	11877	10335	mm/min
		480	n	38197	25465	19099	15279	12732	9549	7639	6112	min^{-1}
	4	vc max [m/min]	vf	11890	12456	12740	12230	11749	10722	9682	8425	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	5	vc max [m/min]	vf	7134	7474	7644	7338	7049	6433	5809	5055	mm/min
		300	n	23873	15915	11937	9549	7958	5968	4775	3820	min^{-1}
	6	vc max [m/min]	vf	4459	4671	4777	4586	4406	4021	3631	3159	mm/min
		225	n	17905	11937	8952	7162	5968	4476	3581	2865	min^{-1}
M	1	vc max [m/min]	vf	10483	10982	11232	10783	10358	9454	8536	7428	mm/min
		345	n	27454	18303	13727	10982	9151	6864	5491	4393	min^{-1}
	2	vc max [m/min]	vf	5707	5979	6115	5870	5639	5147	4647	4044	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	3	vc max [m/min]	vf	4162	4360	4459	4280	4112	3753	3389	2949	mm/min
		210	n	16711	11141	8356	6685	5570	4178	3342	2674	min^{-1}
K	1	vc max [m/min]	vf	15457	16193	16561	15899	15273	13939	12587	10953	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	2	vc max [m/min]	vf	11851	12415	12697	12189	11710	10687	9650	8397	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
	3	vc max [m/min]	vf	9274	9716	9937	9539	9164	8364	7552	6572	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
S	1	vc max [m/min]	vf	8204	8595	8790	8439	8107	7399	6681	5813	mm/min
		270	n	21486	14324	10743	8594	7162	5371	4297	3438	min^{-1}
	2	vc max [m/min]	vf	1902	1993	2038	1957	1880	1716	1549	1348	mm/min
		120	n	9549	6366	4775	3820	3183	2387	1910	1528	min^{-1}
	3	vc max [m/min]	vf	5707	5979	6115	5870	5639	5147	4647	4044	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	4	vc max [m/min]	vf	3805	3986	4077	3914	3760	3431	3098	2696	mm/min
		180	n	14324	9549	7162	5730	4775	3581	2865	2292	min^{-1}
H	1	vc max [m/min]	vf	11098	11626	11890	11415	10965	10008	9037	7863	mm/min
		420	n	33423	22282	16711	13369	11141	8356	6685	5348	min^{-1}

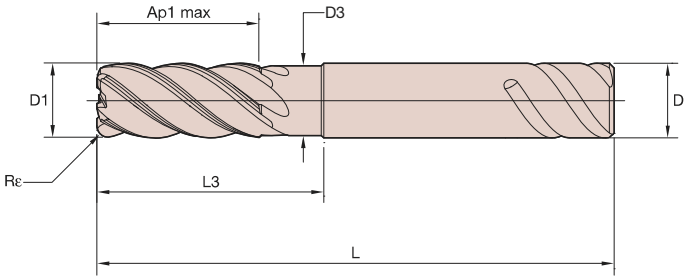
NOTE: For all other combinations of width and depth of cut, feed and speed must be adapted.
Cutting data, which are shown in this catalogue, are applicable under optimum conditions and chip evacuation.

Recommended ae: 0,04 x D, phi~23°, ap = ap max

Speed and feed: 4% ae

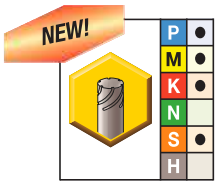
- Kennametal standard dimensions.
- Non-centre cutting.
- Ramping up to 3°.
- Optimised geometry for titanium machining.
- Unequal flute spacing minimises chatter for smoother machining.
- Single tool for both roughing and finishing operations requiring fewer setups.
- Five-flute geometry enables slotting up to 1 x D.

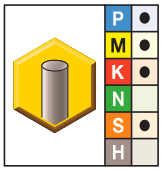


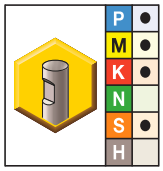


beyond

UDDE • 5-Flute with Neck • Metric





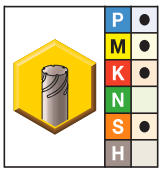


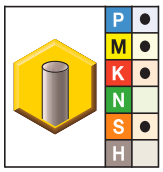
● first choice
○ alternate choice

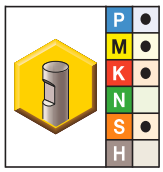
KCSM15	KC643M	KC643M	D1	D	D3	Ap1 max	L3	L	Rε
–	–	UDDE0600B5ARA	6,00	6,00	5,64	13,00	18,00	63,00	0,20
–	UDDE0600A5ARA	UDDE0600B5ARB	6,00	6,00	5,64	13,00	18,00	63,00	0,50
–	UDDE0600A5ARB	UDDE0600B5ARC	6,00	6,00	5,64	13,00	18,00	63,00	1,00
–	UDDE0600A5ARC	UDDE0600B5ARD	6,00	6,00	5,64	13,00	18,00	63,00	1,50
–	UDDE0600A5ASA	–	6,00	6,00	5,64	13,00	18,00	63,00	–
–	–	UDDE0800B5ARA	8,00	8,00	7,52	19,00	24,00	76,00	0,20
–	UDDE0800A5ARA	UDDE0800B5ARB	8,00	8,00	7,52	19,00	24,00	76,00	0,50
–	UDDE0800A5ARB	UDDE0800B5ARC	8,00	8,00	7,52	19,00	24,00	76,00	1,00
–	UDDE0800A5ARC	UDDE0800B5ARD	8,00	8,00	7,52	19,00	24,00	76,00	2,00
–	UDDE0800A5ASA	–	8,00	8,00	7,52	19,00	24,00	76,00	–
–	UDDE1000A5ARA	UDDE1000B5ARA	10,00	10,00	9,40	22,00	30,00	76,00	0,50
–	UDDE1000A5ARB	UDDE1000B5ARB	10,00	10,00	9,40	22,00	30,00	76,00	1,00
–	UDDE1000A5ARC	UDDE1000B5ARC	10,00	10,00	9,40	22,00	30,00	76,00	2,00
–	UDDE1000A5ARD	UDDE1000B5ARD	10,00	10,00	9,40	22,00	30,00	76,00	2,50
–	UDDE1000A5ASA	–	10,00	10,00	9,40	22,00	30,00	76,00	–
UDDE1200E5AQE	UDDE1200A5ARA	UDDE1200B5ARA	12,00	12,00	11,28	26,00	36,00	83,00	0,50
UDDE1200E5AQG	UDDE1200A5ARB	UDDE1200B5ARB	12,00	12,00	11,28	26,00	36,00	83,00	1,00
UDDE1200E5AQK	UDDE1200A5ARC	UDDE1200B5ARC	12,00	12,00	11,28	26,00	36,00	83,00	2,00
UDDE1200E5AQM	UDDE1200A5ARD	UDDE1200B5ARD	12,00	12,00	11,28	26,00	36,00	83,00	3,00
–	UDDE1200A5ASA	–	12,00	12,00	11,28	26,00	36,00	83,00	–
–	UDDE1400A5ARA	UDDE1400B5ARA	14,00	14,00	13,15	26,00	42,00	84,00	0,50
–	UDDE1400A5ARB	UDDE1400B5ARB	14,00	14,00	13,15	26,00	42,00	84,00	1,00
–	UDDE1400A5ARC	UDDE1400B5ARC	14,00	14,00	13,15	26,00	42,00	84,00	2,00
–	UDDE1400A5ARD	UDDE1400B5ARD	14,00	14,00	13,15	26,00	42,00	84,00	3,00

(continued)

(UDDE • 5-Flute with Neck • Metric continued)







KCSM15	KC643M	KC643M	D1	D	D3	Ap1 max	L3	L	Rε
–	UDDE1400A5ASA	–	14,00	14,00	13,15	26,00	42,00	84,00	–
UDDE1600E5AQE	UDDE1600A5ARA	UDDE1600B5ARA	16,00	16,00	15,04	32,00	48,00	100,00	0,50
UDDE1600E5AQG	UDDE1600A5ARB	UDDE1600B5ARB	16,00	16,00	15,04	32,00	48,00	100,00	1,00
UDDE1600E5AQK	UDDE1600A5ARC	UDDE1600B5ARC	16,00	16,00	15,04	32,00	48,00	100,00	2,00
UDDE1600E5AQM	UDDE1600A5ARD	UDDE1600B5ARD	16,00	16,00	15,04	32,00	48,00	100,00	3,00
UDDE1600E5AQN	UDDE1600A5ARE	UDDE1600B5ARE	16,00	16,00	15,04	32,00	48,00	100,00	4,00
–	UDDE1600A5ASA	–	16,00	16,00	15,04	32,00	48,00	100,00	–
UDDE2000E5AQE	UDDE2000A5ARA	UDDE2000B5ARA	20,00	20,00	18,80	38,00	60,00	115,00	0,50
UDDE2000E5AQG	UDDE2000A5ARB	UDDE2000B5ARB	20,00	20,00	18,80	38,00	60,00	115,00	1,00
UDDE2000E5AQK	UDDE2000A5ARC	UDDE2000B5ARC	20,00	20,00	18,80	38,00	60,00	115,00	2,00
UDDE2000E5AQM	UDDE2000A5ARD	UDDE2000B5ARD	20,00	20,00	18,80	38,00	60,00	115,00	3,00
UDDE2000E5AQN	UDDE2000A5ARE	UDDE2000B5ARE	20,00	20,00	18,80	38,00	60,00	115,00	4,00
–	UDDE2000A5ASA	–	20,00	20,00	18,80	38,00	60,00	115,00	–
UDDE2500E5AQE	UDDE2500A5ARA	UDDE2500B5ARA	25,00	25,00	23,50	45,00	75,00	135,00	0,50
UDDE2500E5AQG	UDDE2500A5ARB	UDDE2500B5ARB	25,00	25,00	23,50	45,00	75,00	135,00	1,00
UDDE2500E5AQK	UDDE2500A5ARC	UDDE2500B5ARC	25,00	25,00	23,50	45,00	75,00	135,00	2,00
UDDE2500E5AQM	UDDE2500A5ARD	UDDE2500B5ARD	25,00	25,00	23,50	45,00	75,00	135,00	3,00
UDDE2500E5AQN	UDDE2500A5ARE	UDDE2500B5ARE	25,00	25,00	23,50	45,00	75,00	135,00	4,00
–	UDDE2500A5ASA	–	25,00	25,00	23,50	45,00	75,00	135,00	–

NOTE: For application data, see page C29.

End Mill Tolerances

D1	tolerance e8	D	tolerance h6
≤3	-0,014 / -0,028	≤3	+0 / -0,006
>3–6	-0,020 / -0,038	>3–6	+0 / -0,008
>6–10	-0,025 / -0,047	>6–10	+0 / -0,009
>10–18	-0,032 / -0,059	>10–18	+0 / -0,011
>18–30	-0,040 / -0,073	>18–30	+0 / -0,013

ae/D	Full Slot	50% ae	40% ae	30% ae	20% ae	10% ae	5% ae	4% ae	2% ae
Speed factors vc	0.9	1	1.1	1.2	1.3	1.4	2.5	3	4
Feed factors fz	0.8	1	1	1.1	1.4	2	2.5	3	4.4
phi [°]	180	90	78.46	66.42	53.13	36.87	25.84	23.07	16.26

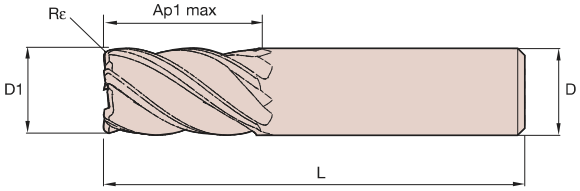
Material Group		Cutting Speed – vc m/min	D	4	6	8	10	12	16	20	25	
P	1	vc max [m/min]	vf	20610	21591	22082	21199	20364	18586	16782	14604	mm/min
		600	n	47746	31831	23873	19099	15915	11937	9549	7639	min^{-1}
	2	vc max [m/min]	vf	19579	20512	20978	20139	19346	17656	15943	13873	mm/min
		570	n	45359	30239	22680	18144	15120	11340	9072	7257	min^{-1}
	3	vc max [m/min]	vf	14585	15280	15627	15002	14412	13153	11877	10335	mm/min
		480	n	38197	25465	19099	15279	12732	9549	7639	6112	min^{-1}
	4	vc max [m/min]	vf	11890	12456	12740	12230	11749	10722	9682	8425	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	5	vc max [m/min]	vf	7134	7474	7644	7338	7049	6433	5809	5055	mm/min
		300	n	23873	15915	11937	9549	7958	5968	4775	3820	min^{-1}
	6	vc max [m/min]	vf	4459	4671	4777	4586	4406	4021	3631	3159	mm/min
		225	n	17905	11937	8952	7162	5968	4476	3581	2865	min^{-1}
M	1	vc max [m/min]	vf	10483	10982	11232	10783	10358	9454	8536	7428	mm/min
		345	n	27454	18303	13727	10982	9151	6864	5491	4393	min^{-1}
	2	vc max [m/min]	vf	5707	5979	6115	5870	5639	5147	4647	4044	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	3	vc max [m/min]	vf	4162	4360	4459	4280	4112	3753	3389	2949	mm/min
		210	n	16711	11141	8356	6685	5570	4178	3342	2674	min^{-1}
K	1	vc max [m/min]	vf	15457	16193	16561	15899	15273	13939	12587	10953	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	2	vc max [m/min]	vf	11851	12415	12697	12189	11710	10687	9650	8397	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
	3	vc max [m/min]	vf	9274	9716	9937	9539	9164	8364	7552	6572	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
S	1	vc max [m/min]	vf	8204	8595	8790	8439	8107	7399	6681	5813	mm/min
		270	n	21486	14324	10743	8594	7162	5371	4297	3438	min^{-1}
	2	vc max [m/min]	vf	1902	1993	2038	1957	1880	1716	1549	1348	mm/min
		120	n	9549	6366	4775	3820	3183	2387	1910	1528	min^{-1}
	3	vc max [m/min]	vf	5707	5979	6115	5870	5639	5147	4647	4044	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	4	vc max [m/min]	vf	3805	3986	4077	3914	3760	3431	3098	2696	mm/min
		180	n	14324	9549	7162	5730	4775	3581	2865	2292	min^{-1}
H	1	vc max [m/min]	vf	11098	11626	11890	11415	10965	10008	9037	7863	mm/min
		420	n	33423	22282	16711	13369	11141	8356	6685	5348	min^{-1}

NOTE: For all other combinations of width and depth of cut, feed and speed must be adapted.
Cutting data, which are shown in this catalogue, are applicable under optimum conditions and chip evacuation.

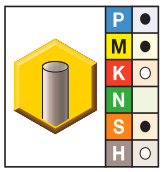
Recommended ae: 0,04 x D, phi~23°, ap = ap max

Speed and feed: 4% ae

- Kennametal standard dimensions.
- Non-centre cutting.
- Unequal flute spacing minimises chatter for smoother machining.
- For finishing and semi-finishing applications.
- Optimised geometry for machining corners at deep cavities.



UGDE • 5-Flute • Metric

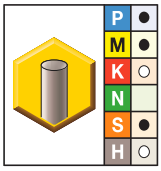


● first choice
○ alternate choice

KC643M	D1	D	Ap1 max	L	Rε
UGDE0600A5ARA	6,00	6,00	18,00	63,00	0,20
UGDE0600A5ARB	6,00	6,00	18,00	63,00	0,50
UGDE0600A5ARC	6,00	6,00	18,00	63,00	1,00
UGDE0600A5BRA	6,00	6,00	30,00	76,00	0,20
UGDE0600A5BRB	6,00	6,00	30,00	76,00	0,50
UGDE0600A5BRC	6,00	6,00	30,00	76,00	1,00
UGDE0800A5ARA	8,00	8,00	24,00	67,00	0,20
UGDE0800A5ARB	8,00	8,00	24,00	67,00	0,50
UGDE0800A5ARC	8,00	8,00	24,00	67,00	1,00
UGDE0800A5BRA	8,00	8,00	40,00	87,00	0,20
UGDE0800A5BRB	8,00	8,00	40,00	87,00	0,50
UGDE0800A5BRC	8,00	8,00	40,00	87,00	1,00
UGDE1000A5ARA	10,00	10,00	30,00	76,00	0,50
UGDE1000A5ARB	10,00	10,00	30,00	76,00	1,00
UGDE1000A5ARC	10,00	10,00	30,00	76,00	2,00
UGDE1000A5ARD	10,00	10,00	30,00	76,00	2,50
UGDE1000A5BRA	10,00	10,00	50,00	100,00	0,50
UGDE1000A5BRB	10,00	10,00	50,00	100,00	1,00
UGDE1000A5BRC	10,00	10,00	50,00	100,00	2,00
UGDE1000A5BRD	10,00	10,00	50,00	100,00	2,50
UGDE1200A5ARA	12,00	12,00	36,00	100,00	0,50
UGDE1200A5ARB	12,00	12,00	36,00	100,00	1,00
UGDE1200A5ARC	12,00	12,00	36,00	100,00	2,00
UGDE1200A5ARD	12,00	12,00	36,00	100,00	2,50
UGDE1200A5BRA	12,00	12,00	36,00	125,00	0,50
UGDE1200A5BRB	12,00	12,00	60,00	125,00	1,00
UGDE1200A5BRC	12,00	12,00	60,00	125,00	2,00
UGDE1200A5BRD	12,00	12,00	60,00	125,00	2,50
UGDE1400A5ARD	14,00	14,00	42,00	100,00	3,00
UGDE1400A5BRD	14,00	14,00	70,00	120,00	3,00

(continued)

(UGDE • 5-Flute • Metric continued)



KC643M	D1	D	Ap1 max	L	Rε
UGDE1600A5ARA	16,00	16,00	48,00	110,00	1,00
UGDE1600A5ARB	16,00	16,00	48,00	110,00	2,00
UGDE1600A5ARC	16,00	16,00	48,00	110,00	2,50
UGDE1600A5ARD	16,00	16,00	48,00	110,00	3,00
UGDE1600A5ARE	16,00	16,00	48,00	110,00	4,00
UGDE1600A5BRA	16,00	16,00	80,00	141,00	1,00
UGDE1600A5BRB	16,00	16,00	80,00	141,00	2,00
UGDE1600A5BRC	16,00	16,00	80,00	141,00	2,50
UGDE1600A5BRD	16,00	16,00	80,00	141,00	3,00
UGDE1600A5BRE	16,00	16,00	80,00	141,00	4,00
UGDE2000A5ARA	20,00	20,00	60,00	125,00	1,00
UGDE2000A5ARB	20,00	20,00	60,00	125,00	2,00
UGDE2000A5ARC	20,00	20,00	60,00	125,00	2,50
UGDE2000A5ARD	20,00	20,00	60,00	125,00	3,00
UGDE2000A5ARE	20,00	20,00	60,00	125,00	4,00
UGDE2000A5BRA	20,00	20,00	100,00	166,00	1,00
UGDE2000A5BRB	20,00	20,00	100,00	166,00	2,00
UGDE2000A5BRC	20,00	20,00	100,00	166,00	2,50
UGDE2000A5BRD	20,00	20,00	100,00	166,00	3,00
UGDE2000A5BRE	20,00	20,00	100,00	166,00	4,00
UGDE2500A5ARA	25,00	25,00	75,00	150,00	1,00
UGDE2500A5ARB	25,00	25,00	75,00	150,00	2,00
UGDE2500A5ARC	25,00	25,00	75,00	150,00	2,50
UGDE2500A5ARD	25,00	25,00	75,00	150,00	3,00
UGDE2500A5ARE	25,00	25,00	75,00	150,00	4,00
UGDE2500A5BRA	25,00	25,00	125,00	190,00	1,00
UGDE2500A5BRB	25,00	25,00	125,00	190,00	2,00
UGDE2500A5BRC	25,00	25,00	125,00	190,00	2,50
UGDE2500A5BRD	25,00	25,00	125,00	190,00	3,00
UGDE2500A5BRE	25,00	25,00	125,00	190,00	4,00

NOTE: For application data, see page C34.

End Mill Tolerances

D1	tolerance e8	D	tolerance h6
≤3	-0,014/-0,028	≤3	+0/-0,006
>3–6	-0,020/-0,038	>3–6	+0/-0,008
>6–10	-0,025/-0,047	>6–10	+0/-0,009
>10–18	-0,032/-0,059	>10–18	+0/-0,011
>18–30	-0,040/-0,073	>18–30	+0/-0,013

ae/D	Full Slot	50% ae	40% ae	30% ae	20% ae	10% ae	5% ae	4% ae	2% ae
Speed factors vc	0.9	1	1.1	1.2	1.3	1.4	2.5	3	4
Feed factors fz	0.8	1	1	1.1	1.4	2	2.5	3	4.4
phi [°]	180	90	78.46	66.42	53.13	36.87	25.84	23.07	16.26

Material Group		Cutting Speed – vc m/min	D	4	6	8	10	12	16	20	25	
P	1	vc max [m/min]	vf	18434	19312	19751	18961	18215	16623	15011	13062	mm/min
		600	n	47746	31831	23873	19099	15915	11937	9549	7639	min^{-1}
	2	vc max [m/min]	vf	17512	18346	18763	18013	17304	15792	14260	12409	mm/min
		570	n	45359	30239	22680	18144	15120	11340	9072	7257	min^{-1}
	3	vc max [m/min]	vf	13046	13667	13977	13418	12890	11764	10623	9244	mm/min
		480	n	38197	25465	19099	15279	12732	9549	7639	6112	min^{-1}
	4	vc max [m/min]	vf	10635	11141	11395	10939	10508	9590	8660	7536	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	5	vc max [m/min]	vf	6381	6685	6837	6563	6305	5754	5196	4521	mm/min
		300	n	23873	15915	11937	9549	7958	5968	4775	3820	min^{-1}
	6	vc max [m/min]	vf	3988	4178	4273	4102	3941	3596	3247	2826	mm/min
		225	n	17905	11937	8952	7162	5968	4476	3581	2865	min^{-1}
M	1	vc max [m/min]	vf	9377	9823	10046	9644	9265	8456	7635	6644	mm/min
		345	n	27454	18303	13727	10982	9151	6864	5491	4393	min^{-1}
	2	vc max [m/min]	vf	5105	5348	5469	5251	5044	4603	4157	3617	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	3	vc max [m/min]	vf	3722	3899	3988	3829	3678	3357	3031	2637	mm/min
		210	n	16711	11141	8356	6685	5570	4178	3342	2674	min^{-1}
K	1	vc max [m/min]	vf	13825	14484	14813	14220	13661	12468	11258	9796	mm/min
		450	n	35810	23873	17905	14324	11937	8952	7162	5730	min^{-1}
	2	vc max [m/min]	vf	10600	11104	11357	10902	10473	9559	8631	7511	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
	3	vc max [m/min]	vf	8295	8690	8888	8532	8197	7481	6755	5878	mm/min
		390	n	31035	20690	15518	12414	10345	7759	6207	4966	min^{-1}
S	1	vc max [m/min]	vf	7338	7688	7862	7548	7251	6617	5975	5200	mm/min
		270	n	21486	14324	10743	8594	7162	5371	4297	3438	min^{-1}
	2	vc max [m/min]	vf	1702	1783	1823	1750	1681	1534	1386	1206	mm/min
		120	n	9549	6366	4775	3820	3183	2387	1910	1528	min^{-1}
	3	vc max [m/min]	vf	5105	5348	5469	5251	5044	4603	4157	3617	mm/min
		240	n	19099	12732	9549	7639	6366	4775	3820	3056	min^{-1}
	4	vc max [m/min]	vf	3403	3565	3646	3500	3363	3069	2771	2411	mm/min
		180	n	14324	9549	7162	5730	4775	3581	2865	2292	min^{-1}
H	1	vc max [m/min]	vf	9926	10399	10635	10210	9808	8951	8083	7033	mm/min
		420	n	33423	22282	16711	13369	11141	8356	6685	5348	min^{-1}

NOTE: For all other combinations of width and depth of cut, feed and speed must be adapted.
Cutting data, which are shown in this catalogue, are applicable under optimum conditions and chip evacuation.

Recommended ae: 0,05 x D, phi~28,8°, ap = ap max

Speed and feed: 5% ae

High-Performance Solid Carbide End Mills

SAFE-λOCK™
by HAIMER

In High-Performance Cutting (HPC), slow microcreeping can cause the cutting tool to be pulled out of the chuck, **turning high-quality workpieces to scrap.**

Be on the Safe Side with SAFE-λOCK™ in High-Performance Cutting (HPC)

Benefits

- Highly accurate clamping due to positive connection.
- No loss of accuracy.
- No pull out or spinning of the tool.
- No damage to the workpiece or machine.
- Groove on tool shank is directed so the tool will be pulled into the chuck (depending on direction of rotation).

Order Information

Kennametal high-performance end mills with a shank diameter of 12mm (1/2") and larger are available with **SAFE-λOCK™** technology, as a special tool, upon request. Please contact your local customer service location to receive a quote.

Features

- Form-closed clamping.
- High accuracy clamping.
- Helical grooves.

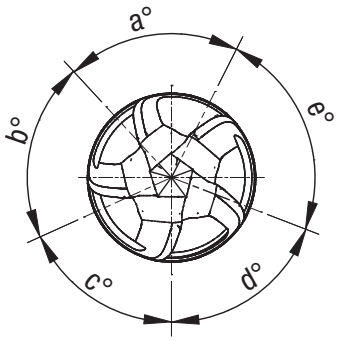
Functions

- No pull out.
- Excellent runout.
- Adjustable clamping length.

Benefits

- Reduce scrap rate.
- Higher tool life.
- No need to change NC programme after regrinding.

Customised-Solution Example for Highest Metal Removal Rates



The HARVI II UDDE proprietary design with **unequal flute spacing** and unique core geometry for chatter-free machining enables slotting operations in titanium up to 1 x D.

SAFE-λOCK™

The safety belt for high-performance solid carbide end mills provides a form-closed clamping with high accuracy and helical grooves for length adjustment.

55813, 10/15

FORTIVA

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